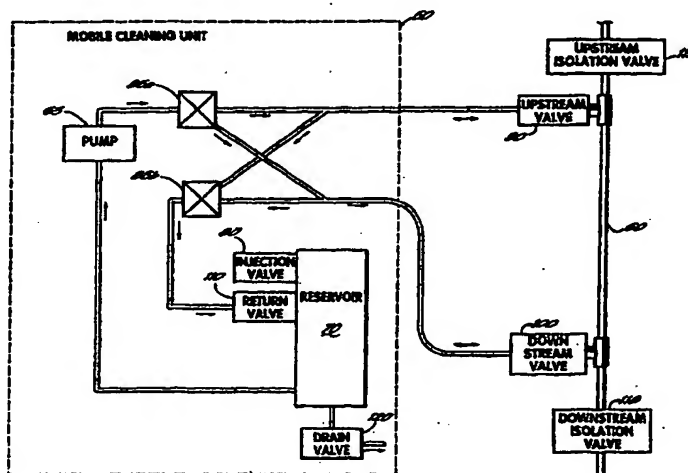




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(21) International Application Number: PCT/US98/04247 (22) International Filing Date: 4 March 1998 (04.03.98) (30) Priority Data: 08/812,273 6 March 1997 (06.03.97) US (71) Applicant: H.E.R.C. PRODUCTS INCORPORATED [US/US]; Suite 15, 2202 Lone Cactus Drive, Phoenix, AZ 85027 (US). (72) Inventors: LUDWIG, Jerome, H.; 8840 N. 57th Street, Paradise Valley, AZ 85253 (US). SHENKIRYK, Myron; 16028 South 12th Place, Phoenix, AZ 85048 (US). TEMPLE, Dan; 908 W. Monterosa, Phoenix, AZ 85013 (US). FYFE, Edward; 4209 N. 85th Drive, Phoenix, AZ 85037 (US). (74) Agents: JOSEPHIC, David, J. et al.; Wood, Herron & Evans, L.L.P., 2700 Carew Tower, Cincinnati, OH 45202 (US).	(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i>	

(54) Title: PIPE SYSTEM CLEANING AND IN-LINE TREATMENT OF SPENT CLEANING SOLUTION



(57) Abstract

A mobile cleaning unit (50) is connected to a fouled pipe (60) to be cleaned. A pump (65) circulates cleaning solution from a reservoir (70) through an injection valve (80) in the mobile cleaning unit (50). The solution is regulated by diverter valves (85a, 85b) to an upstream valve (90), through the pipe (60), out a downstream valve (100), and through a return valve (110) to the reservoir (70). Treatment is monitored at either an upstream (115) or a downstream isolation valve (118). Spent solution is recirculated until it is environmentally safe for discharge out a drain valve (120). The process minimizes both the volume of treated spent solution and the treatment time.

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**PIPE SYSTEM CLEANING AND IN-LINE TREATMENT OF SPENT
CLEANING SOLUTION****FIELD OF THE INVENTION**

This invention relates to a process for pipe system cleaning and in-line treatment of spent pipe system cleaning solution prior to disposal.

5 BACKGROUND OF THE INVENTION

The method disclosed in U.S. Patent 5,360,488 ('488), which is assigned to the assignee of this invention and is hereby incorporated by reference, employs flushing or displacing a spent cleaning solution with fresh system water to remove it from the cleaned
10 system prior to placing the system back into service. The method results in diluting the spent cleaning solution with system water during flushing due to the lack of "plug flow," particularly in larger diameter pipe systems. The net result is an increase in the volume of the waste
stream to be treated and disposed of, and an increase in the time
15 required to carry out the procedure. Also, the reservoir or chemical tank size limits the volume of spent cleaning solution that can be displaced.

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This is particularly important when cleaning long sections or large diameter pipe systems when several tankfuls of the diluted displaced spent cleaning solution may be required. In most cases, the spent cleaning solution, when neutralized to a pH of 6-8, may be disposed of
5 directly to sanitary sewer systems.

Many kinds of distribution, transmission, or other piping systems develop various types of deposits, resulting in undesirable blockage or corrosion of the systems. Examples include chemical process lines, in situ mining transfer lines, automatic sprinkler lines,
10 potable water distribution systems including underground, residential, commercial or industrial systems, gas transmission lines, fire water distribution systems, vacuum waste lines, irrigation systems, waste lines, and related valves, fittings, and hydrants.

Scale or deposits in pipes may be removed by various
15 acidic, basic, or neutral cleaning solutions. The fouled cleaning solutions may require treatment prior to disposal. Acidic and basic cleaning solutions normally must be neutralized prior to disposal, while neutral cleaning solutions may require oxidative, reductive or other treatment. Heavy metals that may be present must be removed, for example, by
20 sulfide or phosphate precipitation and subsequent filtration or centrifugation. There is a need for an improved process for the treatment of spent cleaning solutions employed in the cleaning of various piping systems.

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SUMMARY OF THE INVENTION

The invention provides a method of pipe system cleaning and in-line treatment of a spent pipe system cleaning solution prior to disposal. A fouled pipe system is cleaned with a cleaning solution by circulating the cleaning solution through the pipe system. A treatment agent is added to the circulating spent cleaning solution to render the spent cleaning solution environmentally safe. The selection of treatment agent depends upon the chemical properties of the spent cleaning solution. Typical treatment agents are acids, bases, oxidizing agents, and reducing agents. Treatment agents can also be used that would cause the pipe scale to precipitate or form particulate material, which could be removed by subsequent filtration or centrifugation. In a preferred embodiment, the treatment agent is added to the reservoir of a mobile cleaning unit which receives the spent cleaning solution for circulation. Upon treatment completion, the treated spent cleaning solution is removed from the pipe system for filtration and/or disposal.

BRIEF DESCRIPTION OF THE FIGURE

The Figure is a schematic representation of a mobile cleaning unit used for pipe system cleaning and in-line treatment of spent cleaning solution.

DETAILED DESCRIPTION

Referring to the Figure, a mobile cleaning unit 50 is connected to an isolated pipe 60 to be cleaned. For example, the mobile

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unit and circulation method described in the '488 patent and co-pending application Serial No. 08/547,099 may be used to clean the pipe system and these disclosures are incorporated herein by reference. A pump 65 circulates cleaning solution that is added to the reservoir 70 in the mobile cleaning unit 50 through an injection valve 80. A pair of diverter valves 85a, 85b in the pipe system is selectively regulated so that solution flow through the isolated pipe 60 may be reversed to facilitate cleaning the pipe 60. The cleaning solution is circulated from the reservoir 70, into an upstream valve 90 connected to an upstream end of pipe 60 to be cleaned, through the pipe 60, out a downstream valve 100 connected to a downstream end of pipe 60, and is returned by a return valve 110 to the reservoir 70. Circulation is continued until the pipe 60 is cleaned, evidenced by cessation of carbon dioxide gas, for example, when carbonate-containing scale is cleaned. Aqueous inhibited muriatic acid is typically recirculated to remove scale produced by iron oxide and sediment associated with sulfate-reducing and iron bacteria, as disclosed in the method of cleaning potable water distribution systems described in the '488 patent.

At the end of the cleaning cycle, the spent cleaning solution usually has a pH in the range of 0 to 1. Prior to disposal to a sanitary sewer or another suitable waste site as nonhazardous waste, the spent cleaning solution must be neutralized to a pH of 6-8 or otherwise treated to be rendered environmentally safe.

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Incorporating the techniques of this invention, at the end of the cleaning cycle circulation of the spent cleaning solution is continued while a treatment agent is injected through the injection valve 80 into the reservoir 70 of the mobile cleaning unit 50. The treatment agent is added to the reservoir 70 until the desired pH of the spent cleaning solution is obtained or other treatment is completed. Treatment may be monitored at an upstream end of the pipe 60 through an upstream isolation valve 115. Similarly, treatment may be monitored at a downstream end of the pipe 60 through a downstream isolation valve 118.

The treated spent cleaning solution may then be discharged to waste by opening a drain valve 120 from the reservoir 70. The cleaned water distribution system is likewise flushed with fresh system water directly to waste prior to disconnecting the pipe 60, now cleaned, from the mobile cleaning unit 50.

Spent acidic cleaning solutions may be neutralized with a variety of basic materials, such as sodium hydroxide, sodium carbonate, sodium bicarbonate, potassium hydroxide, ammonium hydroxide, calcium carbonate, calcium hydroxide, calcium oxide, magnesium oxide, ammonia, organic amines, and the like. These may be added as aqueous solutions or as solids to the reservoir 70.

Spent basic cleaning solutions may be neutralized by the addition of a variety of acidic neutralizing materials in a similar manner.

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Mineral acids such as hydrochloric acid, nitric acid, sulfuric acid, phosphoric acid, sulfamic acid, and the like and mixtures thereof, or organic acids such as formic acid, glycolic acid, acetic acid, citric acid, sulfonic acids and the like and mixtures thereof, may be employed to
5 neutralize the spent basic cleaning solutions employed in the cleaning of various pipe systems.

Spent neutral cleaning solutions containing a hazardous species may be rendered nonhazardous by addition of an oxidizing or reducing agent. For example, if the spent treatment solution contains
10 hydrogen sulfide, an oxidizing agent such as potassium permanganate may be added to render the spent cleaning solution nonhazardous. Heavy metals that may be present must be removed, for example, by sulfide or phosphate precipitation and subsequent filtration or centrifugation.

15 The objectives and other advantages of this invention will become apparent in view of the following examples.

EXAMPLE 1

Two hundred feet of an above ground two-inch diameter PVC aqua ammonia process transfer line that was essentially plugged
20 with a hard calcium carbonate deposit was cleaned with an acidic cleaning solution. As stated above, the cleaning solution was circulated through the plugged pipe using a mobile cleaning unit as described in co-pending patent application Serial No. 08/547,099 or the '488 patent.

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This type of open loop system allowed for the controlled removal of carbon dioxide gas that was generated during the acidic cleaning process. When generation of carbon dioxide ceased, the pipe was clean. The cleaning solution, still strongly acidic, was neutralized by adding
5 25% aqueous sodium hydroxide solution to the reservoir with continued circulation of the spent cleaning solution until the solution reached pH 7. The neutralized spent cleaning solution was then pumped to the disposal site and the system was flushed with water prior to placing the PVC transfer pipe back into service.

10

EXAMPLE 2

Ten hundred and fifteen feet of a four-inch diameter potable water distribution system was cleaned with an acidic cleaning solution. A mobile cleaning unit of the type described in Example 1 was connected to a fire hydrant at one end of the isolated section to be
15 cleaned and a tap at the other end. Upon completion of cleaning, circulation of the spent acidic cleaning solution continued and 25% aqueous sodium hydroxide solution was added to the reservoir of the mobile cleaning unit until the spent acidic cleaning solution was neutral. The neutralized spent cleaning solution was then pumped to waste. The
20 cleaned potable water system was flushed with system water prior to being placed back into service.

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EXAMPLE 3

Four hundred feet of a four-inch diameter potable water distribution system, heavily tuberculated with iron and sulfate reducing bacteria-derived blockage, was cleaned with an acidic cleaning solution.

- 5 A mobile cleaning unit of the type described in Example 1 was used. The mobile cleaning unit was connected to two fire hydrants at either end of the isolated section to be cleaned. After the section was cleaned, the spent acidic cleaning solution continued to circulate through the system and a 25% solution of sodium hydroxide was added to the
- 10 mobile cleaning unit reservoir until the spent solution was neutralized. The neutralized spent cleaning solution was then pumped to waste. The cleaned potable water system was flushed with system water prior to being placed back into service.

- Other variations or embodiments of this invention will
- 15 become apparent to one of ordinary skill in this art in view of the above description, and the foregoing embodiments are not to be construed as limiting the scope of this invention.

What is claimed is:

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1. A method of pipe system cleaning and in-line treatment of a spent pipe system cleaning solution prior to disposal comprising:

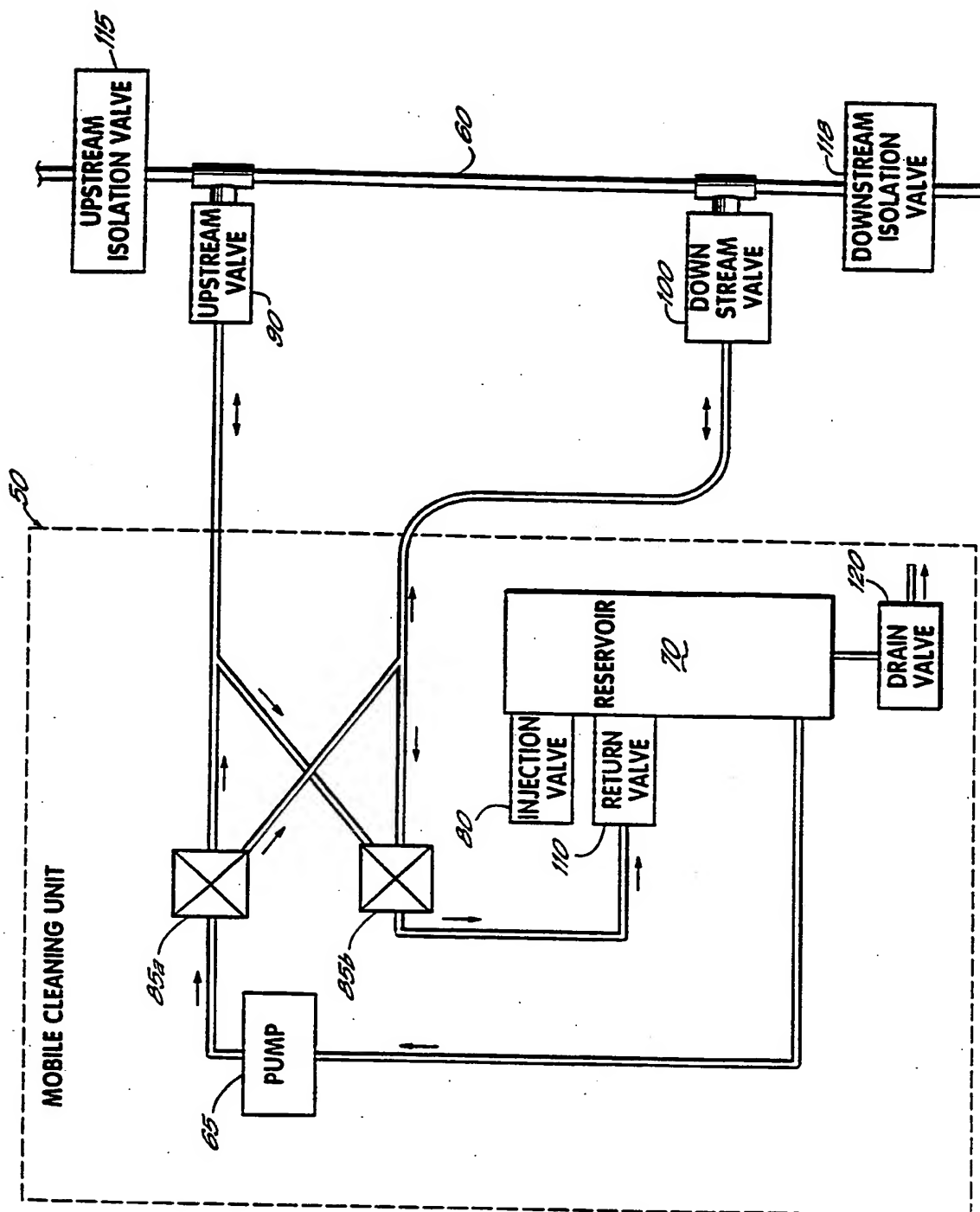
cleaning a pipe system with a cleaning solution to form a spent cleaning solution;

5 recirculating said spent cleaning solution through the cleaned pipe system;

adding a treatment agent to said recirculating spent cleaning solution to render said spent cleaning solution environmentally safe;

10 recirculating said spent cleaning solution containing said treatment agent until said spent cleaning solution is environmentally safe; and

removing said environmentally safe spent cleaning solution from said pipe system for disposal.



INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 98/04247

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B08B9/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B08B C23G C02F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the International search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	see abstract	2-4,7-9
Y	US 5 527 395 A (E.C. PERRY) 18 June 1996 see claims	2-4,8,9
Y	GB 1 109 743 A (PFIZER) 10 April 1968 see claims 1,4	7
Y	US 5 492 629 A (J.H. LUDWIG) 20 February 1996 see claims	1,5,6,8,10
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

5 June 1998

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 523 (C-657), 21 November 1989 & JP 01 212786 A (NEOS), 25 August 1989, see abstract -----	1

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